

FIG. 1

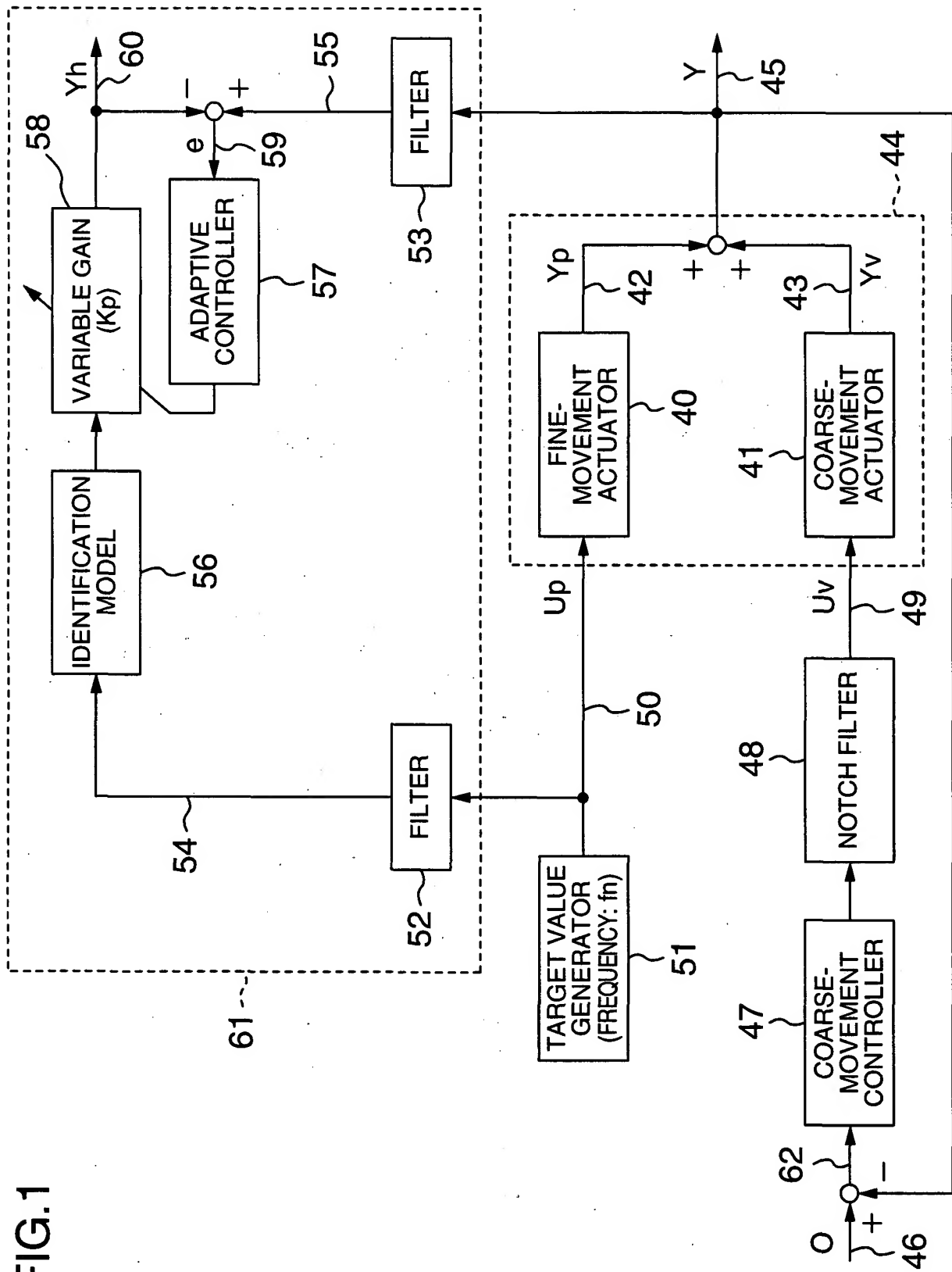


FIG.2

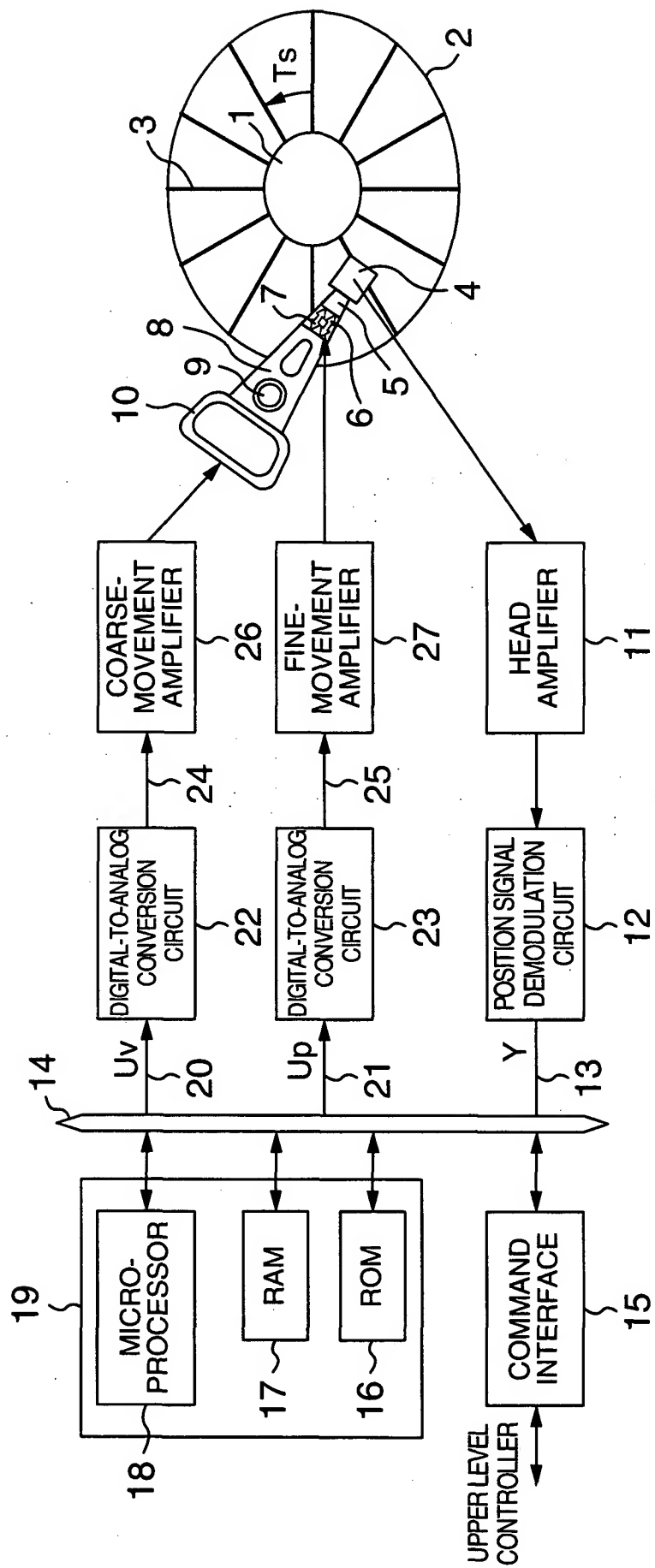


FIG.3A

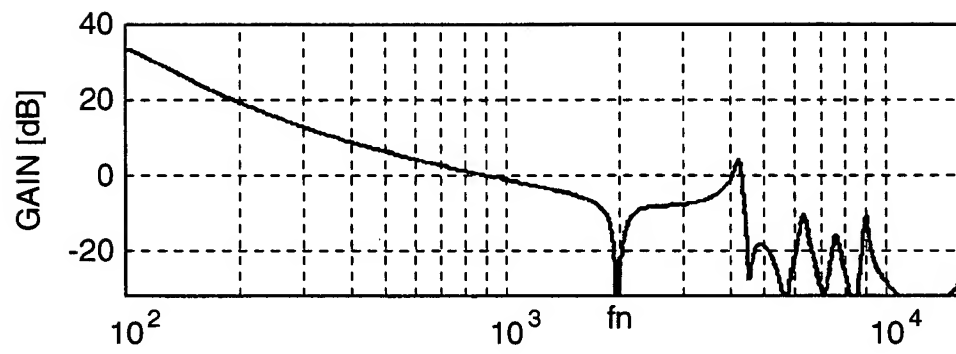


FIG.3B

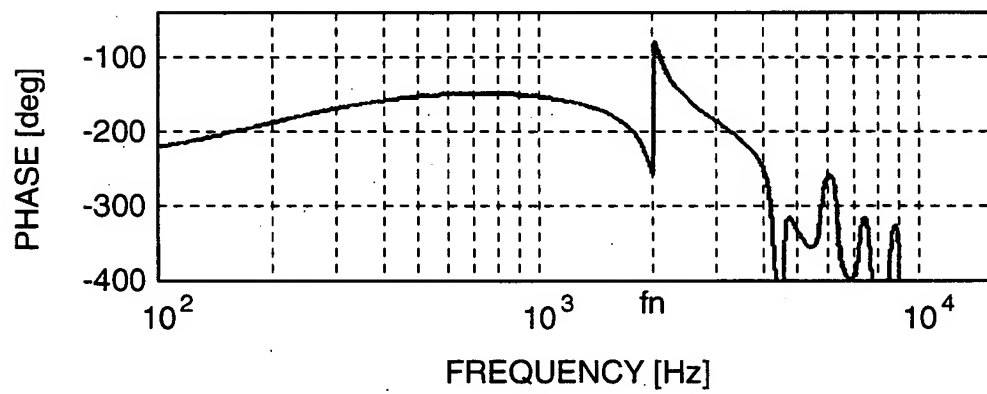


FIG.4A

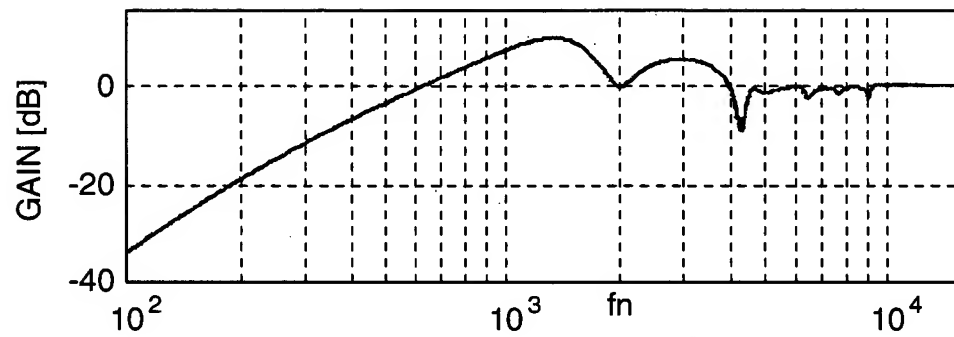


FIG.4B

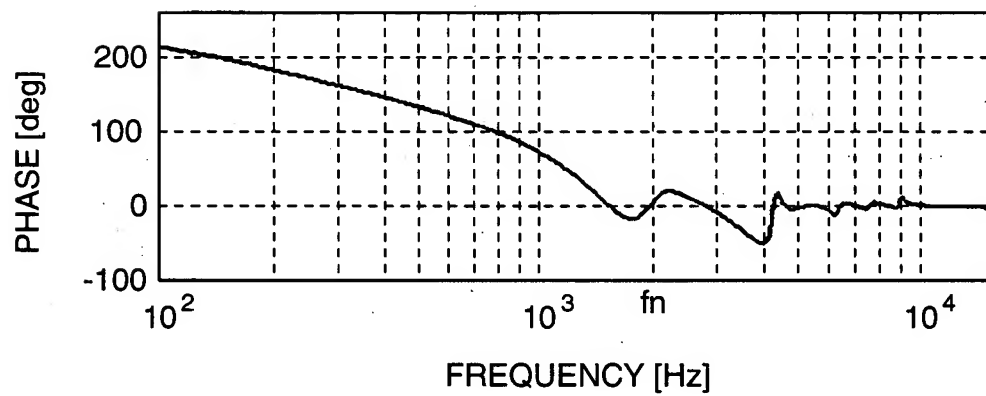


FIG.5A

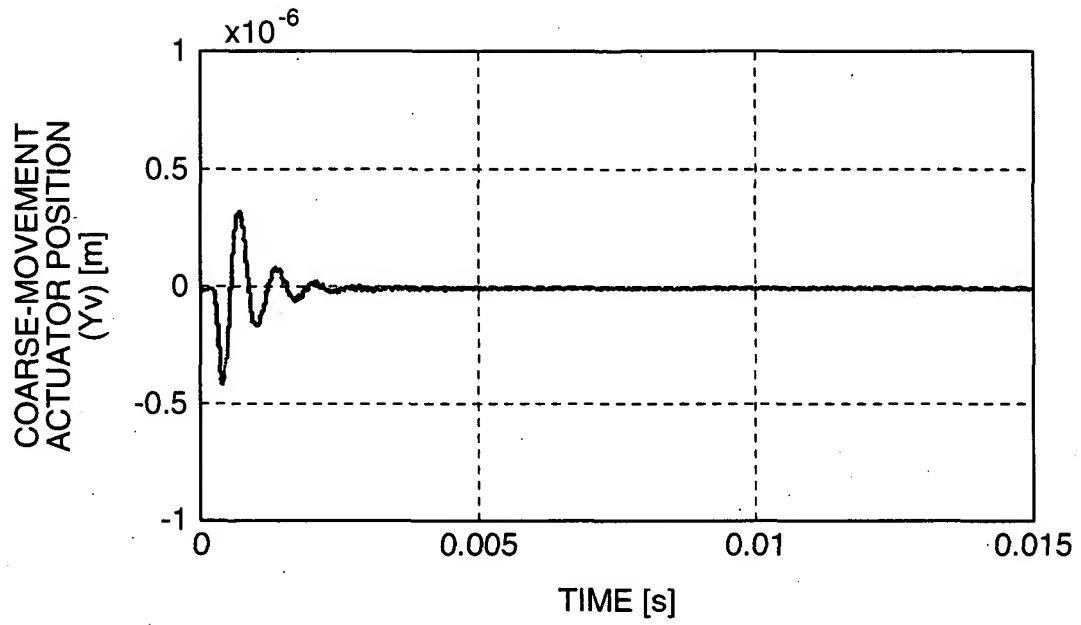


FIG.5B

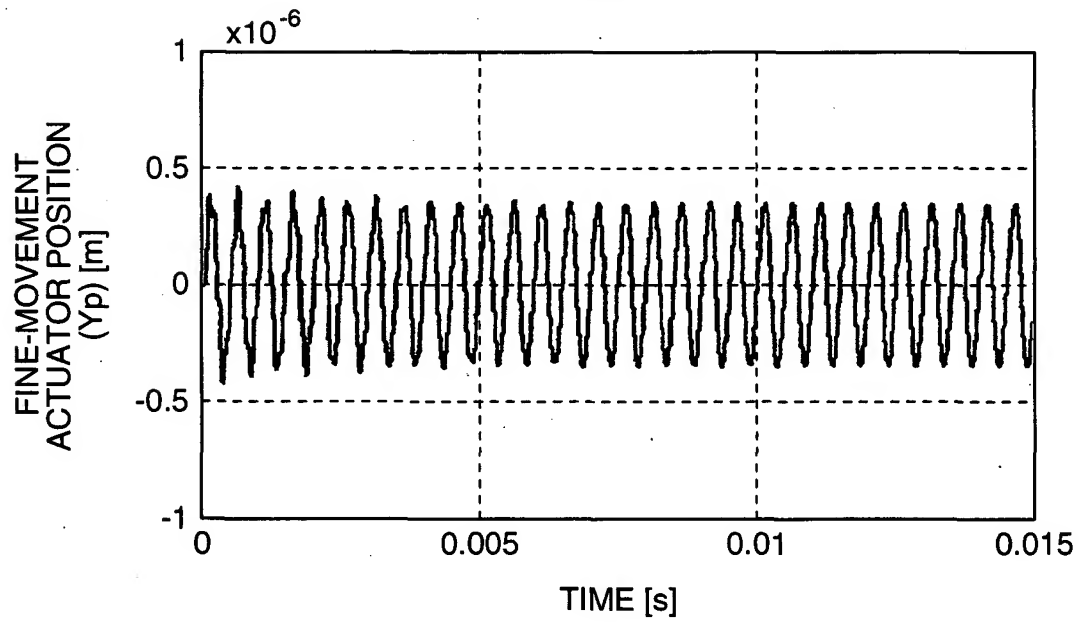


FIG.6A

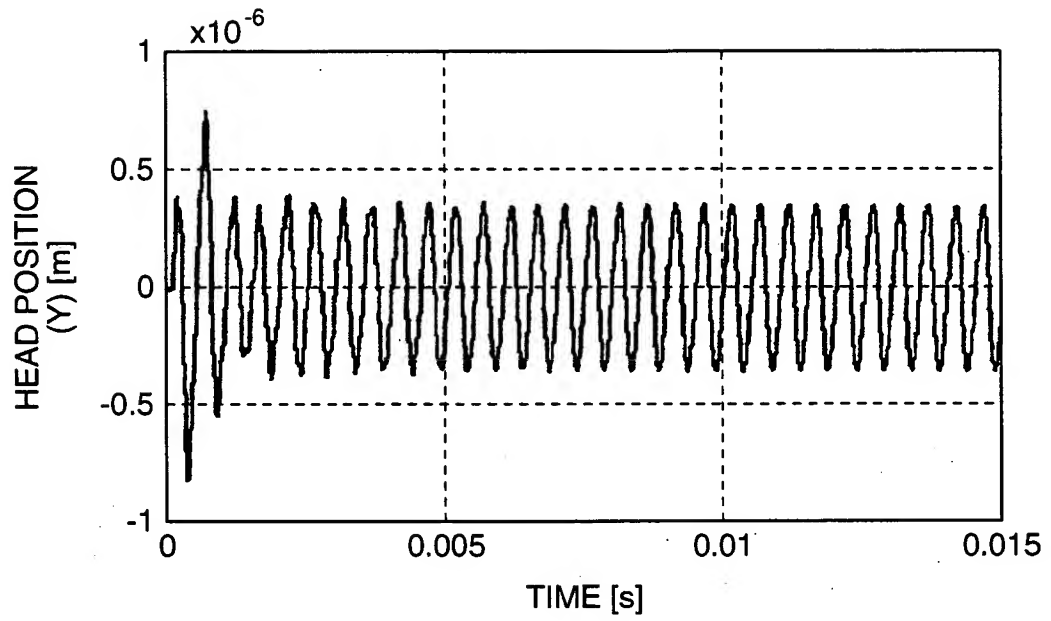


FIG.6B

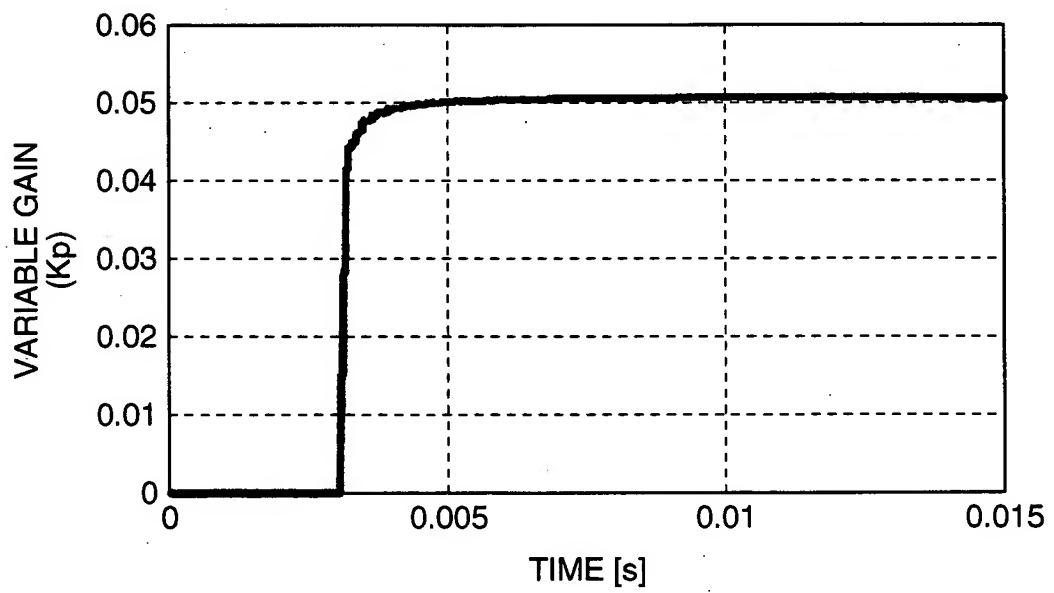


FIG. 7

The diagram illustrates a control system for a two-degree-of-freedom robot arm, organized into two main functional blocks: a coarse movement control section (44) and a fine movement control section (88).

**Coarse Movement Control Section (44):**

- The reference input  $O$  is compared with the current position  $Y$  at summing junction 46 to produce an error signal  $e$ .
- This error signal  $e$  is fed into the **ADAPTIVE CONTROLLER** (83) and also passes through a **FILTER** (76) to produce the reference signal  $Y_h$  (87).
- The error signal  $e$  is also fed into the **COARSE-MOVEMENT IDENTIFICATION MODEL** (79).
- The output of the identification model (78) passes through a **FILTER** (75) to produce the reference signal  $Y_p$  (42).
- The reference signal  $Y_p$  is fed into the **COARSE-MOVEMENT ACTUATOR** (41).

**Fine Movement Control Section (88):**

- The output of the coarse movement actuator (41) is compared with the current position  $Y$  at summing junction 47 to produce an error signal  $U_v$ .
- This error signal  $U_v$  is fed into the **COARSE-MOVEMENT CONTROLLER** (47).
- The output of the coarse movement controller (49) is compared with the current position  $Y$  at summing junction 48 to produce an error signal  $U_p$ .
- This error signal  $U_p$  is fed into the **FINE-MOVEMENT CONTROLLER** (72).
- The output of the fine movement controller (73) is compared with the current position  $Y$  at summing junction 49 to produce an error signal  $U_v$ .
- The output of the fine movement controller (73) is also fed into the **FINE-MOVEMENT IDENTIFICATION MODEL** (81).
- The output of the identification model (77) passes through a **FILTER** (74) to produce the reference signal  $Y_p$  (42).
- The reference signal  $Y_p$  is fed into the **FINE-MOVEMENT ACTUATOR** (40).

**Adaptive Control Loop:**

- The error signal  $e$  is fed into the **ADAPTIVE CONTROLLER** (83), which outputs a gain signal to the **VARIABLE GAIN ( $K_p$ )** block (86).
- The output of the variable gain block (86) is fed into the **FINE-MOVEMENT IDENTIFICATION MODEL** (81).
- The output of the fine movement identification model (77) passes through a **FILTER** (74) to produce the reference signal  $Y_p$  (42).
- The reference signal  $Y_p$  is fed into the **FINE-MOVEMENT ACTUATOR** (40).

The overall system output is the position  $Y$  (45), which is fed back to the summing junctions 46 and 47.

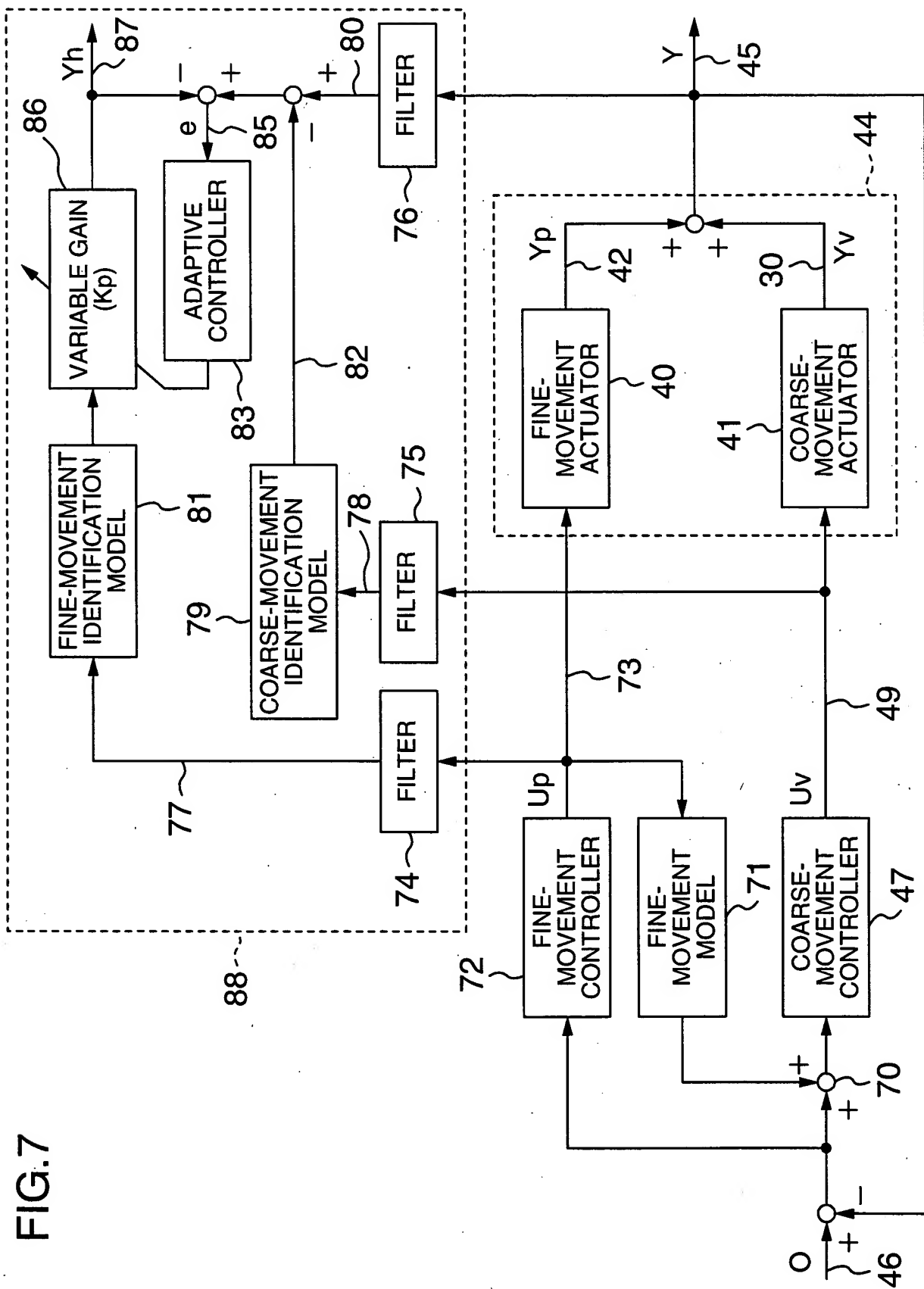


FIG.8

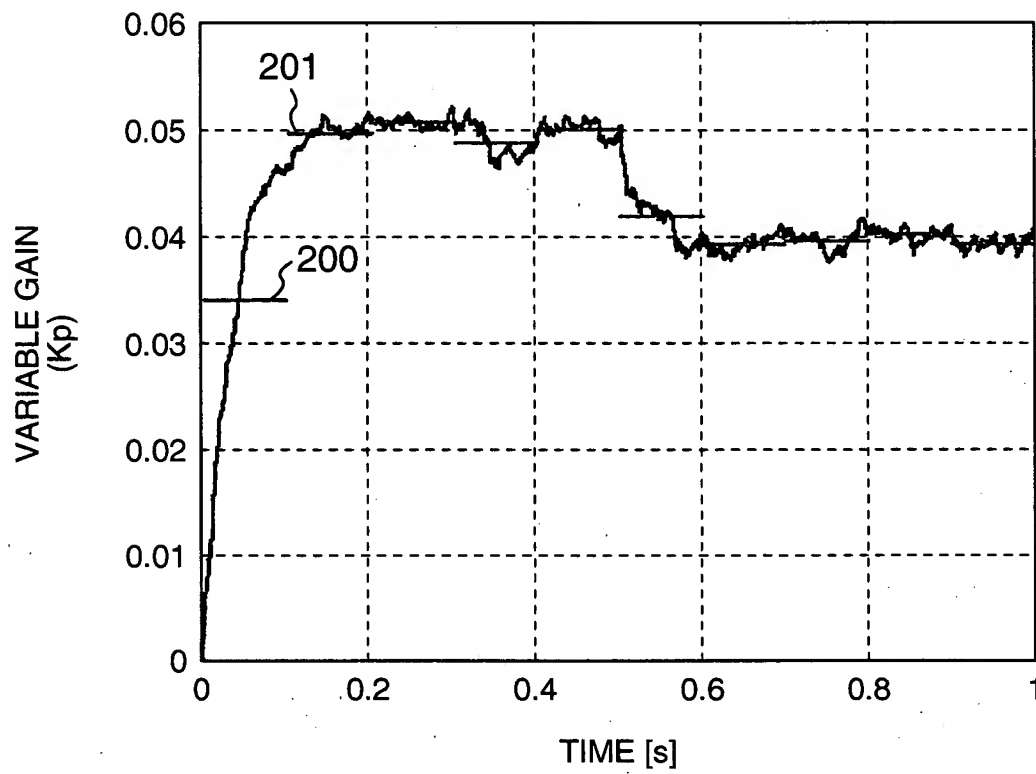




FIG.9

